SLC 5/03™ and SLC 5/04™ Operating Systems

(1747-OS302, FRN10 and 1747-OS401, FRN7)

Read this document prior to using the SLC 5/03 or SLC 5/04 processors. This document update contains information that updates or clarifies previously published information. See the "Summary of Update" table below for specifics.

Purpose of This Document

This Document Update revises the following publication. Keep this Document Update for reference.

Publication Name	Publication Number
SLC 500™ and MicroLogix™ 1000 Instruction Set Reference Manual	1747-6.15

Summary of Update

The following table summarizes the information contained in this Document Update.

Affected Pages	Action to Take	Change
8–22 8–33	Read the "MSG Instruction Operation" section in this publication. Note Change in your Reference Manual.	**page 8-22, Using Status Bits:** Replace the "Time Out Bit TO" text with the "Setting the Internal Time-Out Value" text from this publication. **page 8-33, Using Ladder Logic:** Disregard the ladder logic examples. Refer to the "Example Ladder Programs" in this publication.
B–72	Read the "Day-of-Week with Real Time Clock" section in this publication. Note Change in your Reference Manual.	**For Status Word S:53, add:** Clock/Calendar Day-of-Week This value contains the day-of-week value of the clock/calendar. Valid range is 0–6 (Sunday=0). To disable the clock/calendar, write zeros to all clock and calendar words (S:37 to S:41).
D–5 thru D–7	Read the "Interrupt Latency" section in this publication. Note Change in your Reference Manual	Change the Entry Time values for SLC 5/03 and SLC 5/04 processors to the new values listed in this publication.
H–28	Read the "Interfacing with Enhanced Bar Code Decoders" section in this publication. Note Change in your Reference Manual.	Add the "Interfacing with Enhanced Bar Code Decoders" section of this publication to Appendix H – Application Example Programs.

MSG Instruction Operation for SLC 5/03 Processors (1747-OS302, FRN9 or later) and SLC 5/04 Processors (1747-OS401, FRN5 or later)

The following recommendations for the use of the MSG (message) instruction apply to SLC 5/03 processors (1747-OS302, FRN9 or later) and SLC 5/04 processors (1747-OS401, FRN5 or later). The recommendations must be followed for proper operation of the MSG instruction.

Two example ladder programs are included to illustrate programming the MSG instruction.

Recommendations for Using the MSG Instruction

Limitations for Manipulating the Control Block Bits

Do not manipulate the MSG instruction control block values. For example, do not clear the first word of the control block, do not unlatch the time-out control bit, and so on.

The only MSG instruction control bits that may be manipulated by the ladder program without adversely affecting the operation of the instruction are the EN and TO bits. The enable bit (EN = bit 15) may be unlatched, but only when the done bit (DN = bit 13) or error bit (ER = bit 12) has been set, indicating the successful or unsuccessful completion of the previous message.

In addition, when a MSG is in progress and the ladder program wishes to terminate it for any reason, this may be done by enabling the time-out bit (TO = bit 8). The next time the processor scans the MSG instruction with the TO bit set, it will error the MSG (ER = 1). The MSG instruction may then be re-enabled with a false-to-true transition on the next program scan.

Initiating the MSG Instruction

To invoke the MSG instruction, toggle the MSG instruction rung from false-to-true. Do not toggle the rung again until the MSG instruction has successfully or unsuccessfully completed the previous message, indicated by the processor setting either the DN or ER bit.

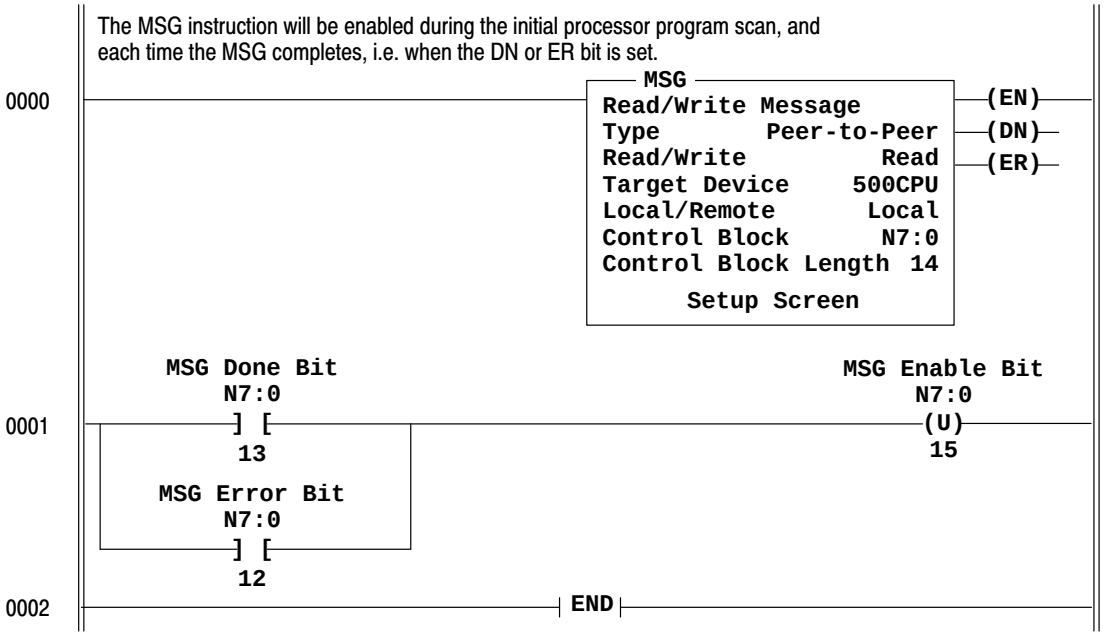
Setting the Internal Time-Out Value

A value greater than 0 must be entered for the MSG instruction time-out parameter. A time-out value of 0 means no time-out value. In other words, if communication is interrupted, the processor will wait forever for a reply. If a reply is not received, the MSG instruction will appear to be locked up.

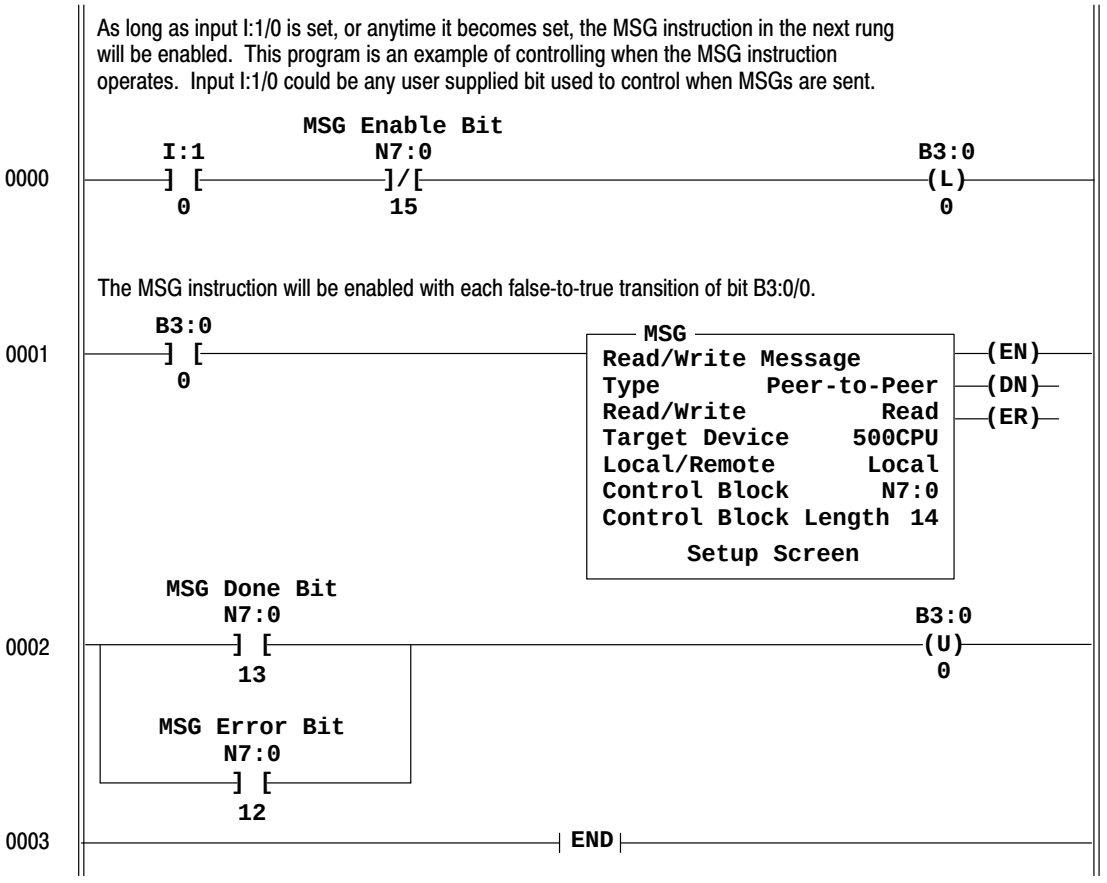
When a value greater than 0 is entered for the MSG time-out parameter and communication is interrupted, the MSG instruction will time-out after the time-out expires, allowing the user program to retry the same message if desired.

Example Ladder Programs

Enabling the MSG Instruction Via Ladder Logic



Enabling the MSG Instruction Via User Supplied Input



Day-of-Week with Real Time Clock

The SLC 5/03 (1747-OS302, FRN10) and SLC 5/04 (1747-OS401, FRN7) processors now support the Day-of-Week feature as part of the Real Time Clock. Although this feature is not yet supported by programming software, you can access Day-of-Week via ladder programming.

The Day-of-Week status word must be initialized. Initialization is done by setting the year, month, and date in the system status file. The status words for setting these values are:

Calendar Status Words		
	Status Word	**Valid Range**
Year	S:37	0–65535
Month	S:38	1–12 (January = 1)
Date	S:39	1–31 (first day of month = 1)

Once the date has been set, the processor determines the Day-of-Week and writes it to S:53. S:53 is read-only and non-volatile. Interpret the Day-of-Week values as shown below:

Day-of-Week Integer Values						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
0	1	2	3	4	5	6

Note: If the status of word S:53 is not properly initialized, it will contain a random value.

Interrupt Latency

There are new interrupt latency specifications for the SLC 5/03 (1747-OS302, FRN10) and SLC 5/04 (1747-OS401, FRN7) processors. Use the values shown below for calculating interrupt latency for Selectable Timed Interrupt (STI), Discrete Input Interrupt (DII), and I/O Interrupt (IOI).

Entry Time		
	SLC 5/03 Processors	**SLC 5/04 Processors**
STI	425 µs	355 µs
DII	440 µs	365 µs
IOI	715 µs	595 µs

Interfacing with Enhanced Bar Code Decoders Over DH-485 Network Using the MSG Instruction

The purpose of this section is to illustrate how to interface Allen-Bradley Enhanced Bar Code Decoders to SLC 5/03 and 5/04 processors via the DH-485 network. Enhanced Bar Code Decoders act only as slave devices on this network. This means that these decoders cannot initiate the transfer of data to a host device, such as the SLC 5/03 or SLC 5/04 processor on DH-485. The SLC processor must initiate commands to a decoder and "poll" that decoder for the reply to those commands.

Processor and Decoder Operation

The Enhanced Bar Code Decoder (catalog number 2755-DS/DD, Series B), when used as a node on a DH-485 network can act as a slave only. This means that the decoder may not initiate communications to any other node on the network. Therefore, in order for a device to get bar code data from an Enhanced Bar Code Decoder on a DH-485 network, that device must send a "read" command and then "poll" the decoder for the reply with data.

The only devices capable of polling a slave device on DH-485 are the SLC 5/03 and 5/04 processors. For the SLC 5/03 processors (1747-OS302, FRN10 or later), polling can be done via channels 0 and 1. For the SLC 5/04 processors (1747-OS401, FRN7 or later), channel 0 supports this capability.

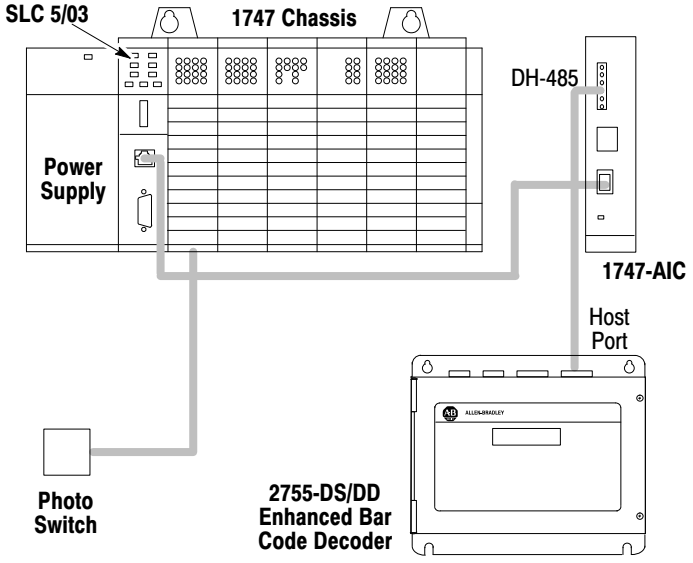
There are many ways to "trigger" bar code decoders to read a bar code label when a label is present.

- a package detect switch wired to both an SLC input module and the bar code decoder
- a package detect switch wired only to an SLC input and an SLC output then used to "trigger" the decoder
- via a software "trigger" command from the SLC processor

For this example, the software "trigger" is used. However, the basic principal is the same for all "trigger" modes.

System Set Up

In this example, a photo switch is located such that when it detects a product is in position for the bar code scanner to read a bar code label on the product, a discrete input to the SLC 5/03 processor is energized.



The 5/03 ladder program then initiates a “MSG Write” to the decoder to “trigger” the decoder to start scanning for a valid bar code label. When the decoder is scanning for a valid bar code label, it operates as shown below:

Result of Scan	Bar Code Decoder Response	Processor Response
Good Read	turns on its “Good Read” onboard output wired to the SLC processor	When one of these two inputs to the SLC are turned on, the SLC will initiate a “MSG Read” to the decoder to get the label data or no-read message data.
No-Read	turns on its “No-Read” onboard output wired to the SLC processor	

In this case, the good read output will be turned on as soon as a valid read occurs, and the no-read output will be turned on after the decoder has attempted to read a label for a specified amount of time and could not.

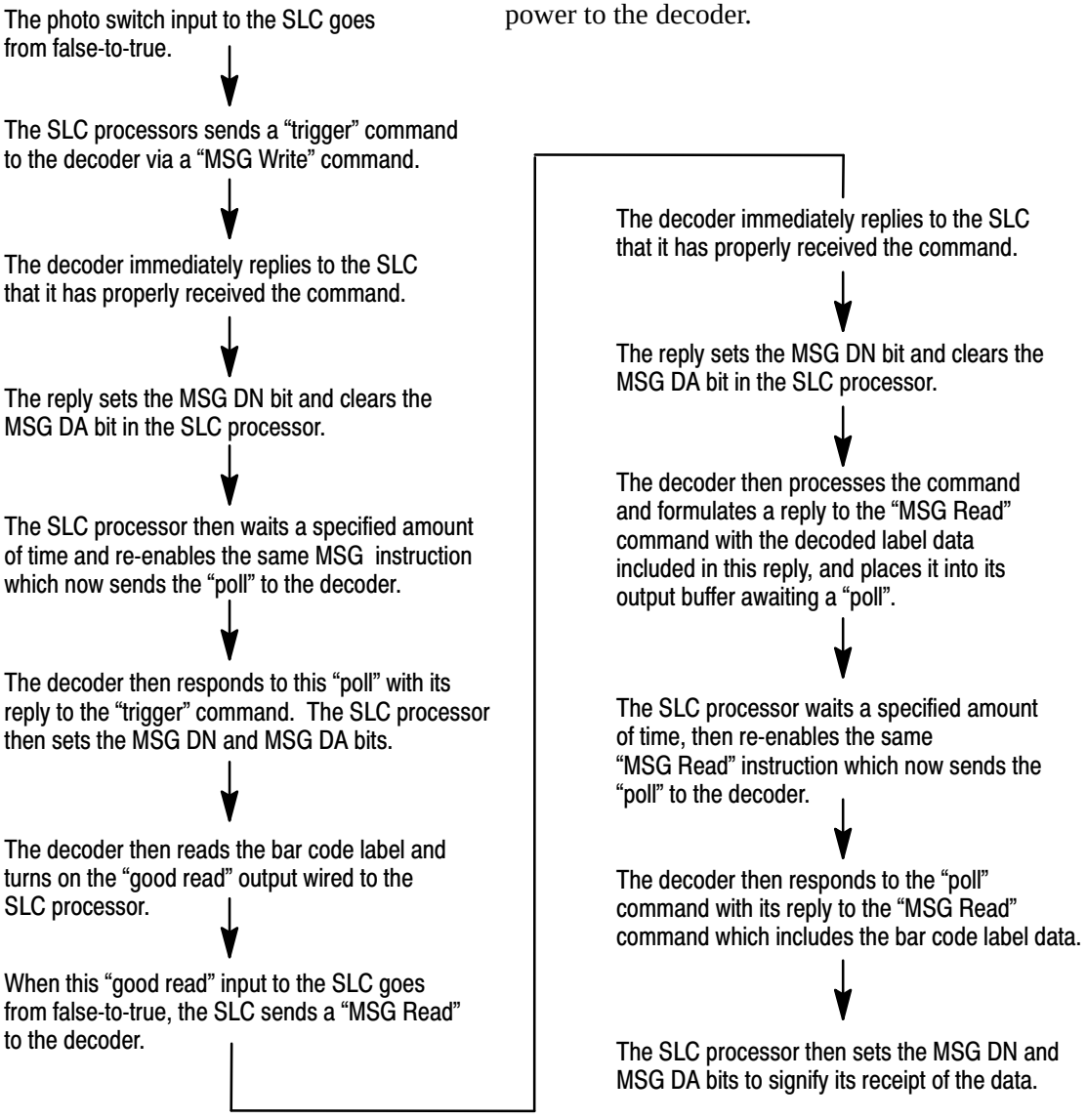
The amount of time the decoder will attempt to read a label is variable and is called the “No-Read Timer”. For this example it is assumed that the product is moving by the scanner and if the label is not read in 2 seconds, it will not be read at all. Therefore the “No-Read Timer” parameter in the bar code decoder will be set to 2 seconds. Refer to the *DS/DD Series B Enhanced Bar Code Decoders (Bulletin 2755) User’s Manual*, publication 2755-833, for details concerning the configuration of your Allen-Bradley Enhanced Bar Code Decoder.

Operating Sequence

With the bar code decoder configured as previously described, the following series of events will take place when a product with a good bar code label breaks the photo switch and this input to the SLC goes from false-to-true. The SLC 5/03 ladder program logic to make it happen is also included. Please note that, as previously stated, a bar code/SLC system may be configured in a variety of ways.

Important: Messages sent by the SLC processor to the Enhanced Bar Code Decoder must be programmed as shown by the example ladder program on page 9. If this logic is not followed, the communication between the two DH-485 devices could become out of sequence, resulting in no data transfers between the decoder and the SLC processor. To correct such a problem, cycle power to the decoder.

Sequence of Events



NOTE: These events are described in more detail by the comments listed within the example ladder program page 9.

Optimizing MSG Time-Out

If the time delay between sending a command to an Enhanced Bar Code Decoder and "polling" for the reply is not long enough, the MSG instruction will time-out (MSG TO bit = 1) each time it is enabled from that point forward. To re-synchronize the SLC processor and the decoder, you will need to cycle power on the decoder to clear its buffer.

There are other ways of clearing the buffers in the decoder, such as sending a "Clear Buffers" command or a "Reset" command to the decoder. However, the best way to handle this issue is to never let it happen. Optimizing the time delay between sending the initial command and "polling" for the reply is the best way to accomplish this. The delay must be long enough so the decoder will have enough time to formulate a reply to the command and short enough to not impact the throughput of the application.

Example MSG Instruction Configuration

The example SLC 5/03 and SLC 5/04 ladder program demonstrates how to send commands to an Enhanced Bar Code Decoder, and then after a time delay, "poll" for a reply. The internal setup screen parameters for the two MSG instructions in the example ladder program are shown below, along with the necessary Enhanced Bar Code Decoder configuration parameters.

SLC 5/03 and SLC 5/04 Internal Set Up Screen Parameters

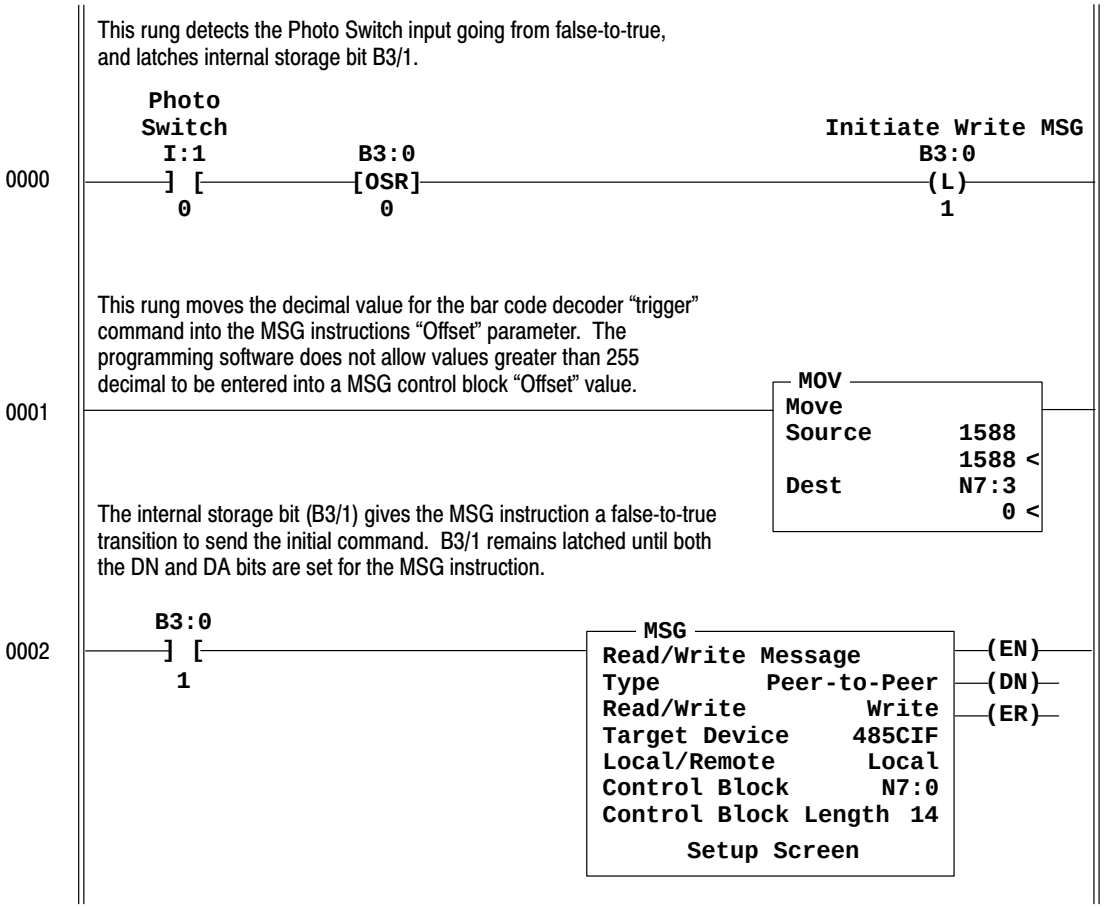
	MSG #1	MSG #2
Type	peer-to-peer	peer-to-peer
Read/write	write	read
Target device	485CIF	485CIF
Local/remote	local	local
Control block	N7:0	N7:20
Channel	1	1
Target Node	2	2
Our source file address	N7:15	N7:40
Target CIF offset①	0	0
Message length in elements	1	10
Message time-out (seconds)	5	5

① The Target CIF Offset when working with Enhanced Bar Code Decoders as slaves on DH-485 must contain a value greater than 255. However, 255 is the largest value SLC programming software will allow you to enter into this parameter in a MSG instruction. Therefore, use an unconditioned rung with a MOV instruction to move the proper value into the Target CIF Offset field. The example ladder program in this section demonstrates this. Note that 1588 decimal in a "MSG Write" is the value which results in a properly configured Enhanced Bar Code Decoder to initiate the "trigger" function. A value of 256 in a "MSG Read" requests a specified number of words of data from the bar code decoder. In this example, we are reading 10 words or 20 characters (bytes).

Example Scanner and Decoder Configuration

Scanner Configuration Parameters		2755-DS/DD Series B Enhanced Bar Code Decoder Configuration Parameters	
Scanner Control Page		**Host Communications Page**	
Discrete I/O:	Read Package 25ms No-Read Package 25ms	Baud Rate:	19200
Laser Light:	Triggered	Bits/Char:	8 Data 1 Stop
Decode Mode:	Host	Parity:	Even
No-Read Time:	2000 ms	Host Protocol:	DH485 PCCC-1
Inter Scan Time:	none	Device Address:	2
Capture Count:	2	ACK Char:	none
Symbols/Scan:	1	NAK Char:	none
Symbols/Package:	1	Large Buffer:	No
Match Complete:	1	Send Host Message:	Immediately after Valid Package
		Transmission Check:	none

Example Ladder Program



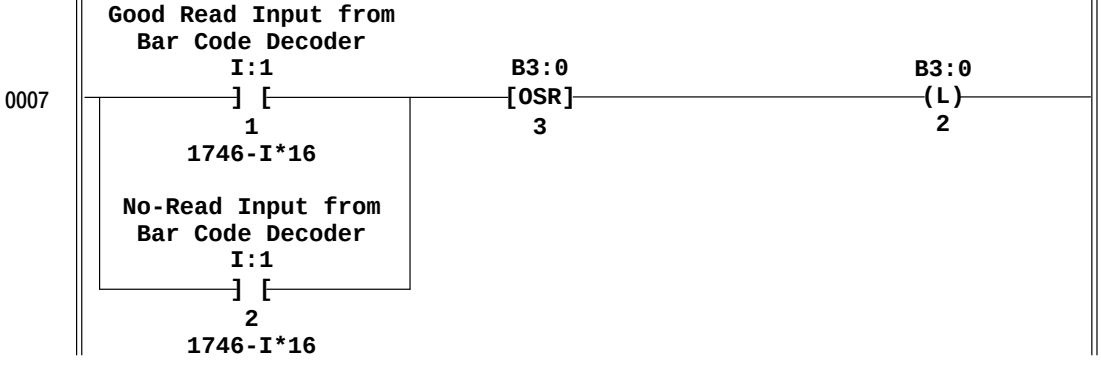
The initial reply from an Enhanced Bar Code Decoder will result in MSG DN = 1 and MSG DA = 0. This simply indicates that the decoder has received the command, but has not yet formulated a reply. The maximum time delay needed between sending the initial command and sending a poll to get the reply is 250 ms. In most cases this delay could be much less (30 ms to 100 ms), depending on the number of features the decoder is configured for.

The internal storage bit, B3/1, holds the MSG instruction true until DN and DA are both set, indicating completion of the command sent and reply received sequence. When DN is set and DA is reset, unlatching the MSG EN bit will effectively toggle the MSG instruction the same as if the MSG rung were toggled, i.e. rung conditions made false, then true. The MSG instruction is toggled one time after DN and NOT DA plus some time delay, to send a final poll to the decoder to get the MSG reply. When the reply is received, the SLC processor will set DN and DA.

When the SLC processor sets both DN and DA for a MSG instruction, the MSG sequence to an Enhanced Bar Code Decoder is complete. In this case, the decoder has received the "trigger" command and has performed this command. Therefore, unlatch B3/1 at this time to be ready for the next request for "trigger".

If an error occurs with the MSG instruction, the ER bit is set. If this occurs, the user can either try to resend the same message again by unlatching EN, or at this point, could sound an alarm or route the product down a rework loop or some other similar action. If the latter choice is used, you must also unlatch B3/1 at this time to be ready for the next request for "trigger".

This rung detects false-to-true transitions of either a good read or a no-read input from the bar code decoder and latches internal storage bit B3/2. B3/2 will then, in the next rung, initialize the MSG read command to the decoder. This is done if either a good read or a no-read occurs, because the no-read message configured in the decoder is data as much as actual bar code label data. Therefore, the ladder program must distinguish between data that means no-read as well as actual bar code label data.



This rung moves the decimal value for the bar code decoder “Read” command into the MSG instruction’s “Offset” parameter. The programming software does not allow values greater than 255 decimal to be entered into a MSG control block “Offset” value.

0008

```
MOV
Move
Source      1588
            1588 <
Dest        N7:3
               0 <
```

The internal storage bit, B3/2, gives the MSG instruction a false-to-true transition to send the initial command. B3/2 remains latched until both DN and DA are set.

0009

```
   B3:0                MSG
 ] [                   Read/Write Message          (EN)
  2                    Type       Peer-to-Peer     (DN)
                       Read/Write         Read     (ER)
                       Target Device    485CIF
                       Local/Remote      Local
                       Control Block     N7:20
                       Control Block Length 14
                             Setup Screen
```

The initial reply from an Enhanced Bar Code Decoder will result in MSG DN = 1 and MSG DA = 0. This indicates that the decoder has received the command, but has not yet formulated a reply. The maximum time delay needed between sending the initial command and sending a poll to get the reply is 250 ms. In most cases this delay could be much less (30 ms to 100 ms), depending on the number of features the decoder is configured for.

0010

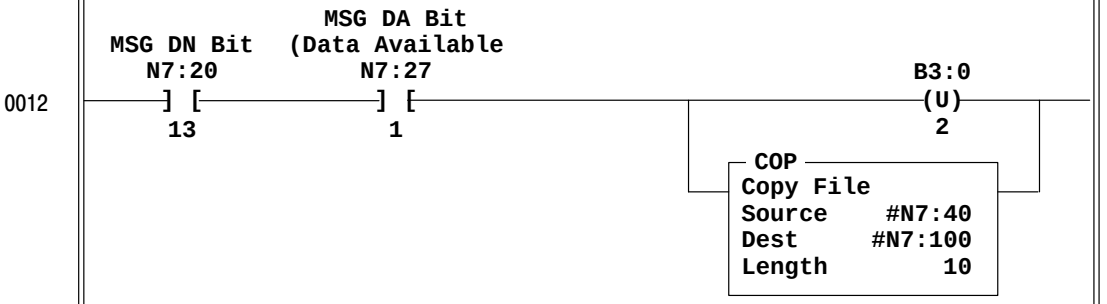
```
                  MSG DA Bit
 MSG DN Bit   (Data Available)
   N7:20           N7:27                TON
 ] [              ]/[                  Timer On Delay     (EN)
  13               1                   Timer      T4:1    (DN)
                                       Time Base  0.01
                                       Preset      250 <
                                       Accum         0 <
```

The internal storage bit, B3/2, holds the MSG instruction true until DN and DA are both set, indicating completion of the command sent and reply received sequence. When DN is set and DA is reset, unlatching the MSG EN bit will effectively toggle the MSG instruction the same as if the MSG rung were toggled, i.e. rung conditions made false, then true. The MSG instruction is toggled one time after DN and NOT DA plus some time delay, to send a final poll to the decoder to get the MSG reply. When the reply is received, the SLC processor will set DN and DA.

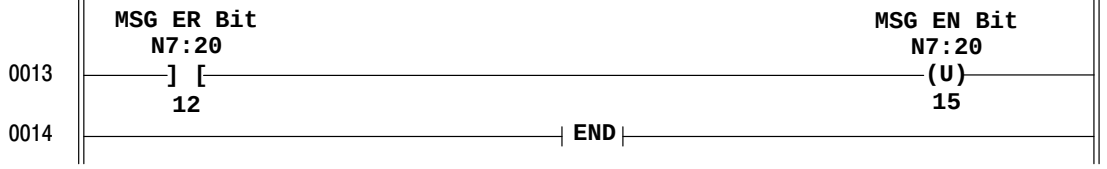
0011

```
   T4:1                                    MSG EN Bit
 ] [                                         N7:20
  DN                                        (U)
                                            15
```

When the SLC processor sets both DN and DA for a MSG instruction, the MSG sequence to an Enhanced Bar Code Decoder is complete. In this case, the decoder has received the "Read" command and has formulated a reply to this command. Therefore, unlatch B3/2 at this time to be ready for the next "Read" request. In addition, when DN and DA are both set, this indicates that the data received with the read reply (except "no-read" data) is valid and may be buffered or used.



If an error occurs with the MSG instruction, the ER bit is set. If this occurs, the user can either try to resend the same message again by unlatching EN, or at this point, could sound an alarm or route the product down a rework loop or some other similar action. If the latter choice is used, you must also unlatch B3/2 at this time to be ready for the next "Read" request.



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